Understanding the Basics of

WASTEWATER TREATMENT

A PUBLICATION OF SAMCO TECHNOLOGIES

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Chapter One

WHAT IS A WASTEWATER TREATMENT SYSTEM AND HOW DOES IT WORK?

WASTEWATER TREATMENT SYSTEMS

What they are and how they work

For an industrial company producing wastewater as part of its process, some type of wastewater treatment system is usually necessary to ensure safety precautions and discharge regulations are met.

The most appropriate wastewater treatment system will help the facility avoid harming the environment, human health, and a facility's process or products if the wastewater is being reused. It will also help the facility curb heavy fines and possible legal action if wastewater is being improperly discharged into a POTW (publicly owned treatment works) or to the environment (usually under a National Pollutant Discharge Elimination System, or NPDES, permit).

But **what is a wastewater treatment system and how does it work**? The complex answer to this question (which largely depends on the wastewater characterization in relation to regulatory requirements for discharge from the plant) is simplified and broken down for you in the following text.

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What is a wastewater treatment system?

A wastewater treatment system is **a system made up of several individual technologies that address your specific wastewater treatment needs**.

Treating wastewater is rarely a static process, and a wastewater treatment system that is engineered to accommodate fluctuations in treatment needs will go a long way in avoiding costly replacements and/or upgrades down the line.

An efficient and well-designed wastewater treatment system should be able to handle:

- process variations in contamination and flow
- variations in water chemistry needs and required chemical volumes adjustments
- possible changes in water effluent requirements

What's included in a basic wastewater treatment system?

As mentioned above, the exact components of a wastewater treatment system depend on the **wastewater characterization** in relation to **regulatory requirements** for discharge from the plant, but in general, a basic wastewater treatment system typically includes some type of:

- **clarifier** to settle suspended solids that are present as a result of treatment
- **chemical feed** to help facilitate the precipitation, flocculation, or coagulation of any metals and suspended solids
- **filtration** to remove all the leftover trace amounts of suspended solids (again, the level of filtration needed will depend on the degree of suspended solids removal required to pass local discharge regulations)
- **Final pH adjustment** and any post treatment
- **control panel** (depending on the level of automated operation needed)

Depending on the needs of your plant and process, these standard components are usually adequate, however, if your plant requires a system that provides a bit more customization, **there might be some features or technologies you will need to add on**.

For example, for facilities that generate biological demand, such as food and beverage companies, a biological treatment system will be required to reduce the BOD (biochemical oxygen demand), etc.

What does a wastewater treatment system typically remove?

A wastewater treatment system might be made up of the technologies necessary to remove any number of the following, which we describe in greater detail in a later chapter:

- Biochemical oxygen demand
- Nitrates and phosphates
- Pathogens
- Metals
- Total suspended solids
- Total dissolved solids
- Synthetic chemicals

How does a wastewater treatment system work?

Specific treatment processes vary, but a typical wastewater treatment facility process will usually include the following steps:

Coagulation

Coagulation is a process where various chemicals are added to a reaction tank to remove the bulk suspended solids and other various contaminants. This process starts off with an assortment of mixing reactors, typically one or two reactors that add specific chemicals to **take out all the finer particles in the water** by combining them into heavier particles that settle out. The most widely used coagulants are aluminum-based such as alum and polyaluminum chloride.

Sometimes a slight pH adjustment will help coagulate the particles, as well.

Flocculation

When coagulation is complete, the water enters a flocculation chamber where the coagulated particles are slowly stirred together with long-chain polymers (charged molecules that grab all the colloidal and coagulated particles and pull them together), **creating visible, settleable particles** that resemble snowflakes.

Sedimentation

The gravity settler (or sedimentation part of the wastewater treatment process) is typically a large circular device where flocculated material and water flow into the chamber and circulate from the center out. In a very slow settling process, the water rises to the top and overflows at the perimeter of the clarifier, **allowing the solids to settle down to the bottom of the clarifier into a sludge blanket**. The solids are then raked to the center of the clarifier into a cylindrical tube where a slow mixing takes place and the sludge is pumped out of the bottom into a sludge-handling or dewatering operation.

The dewatering process takes all the water out of the sludge with filter or belt presses, yielding a solid cake. The sludge water is put onto the press and runs between two belts that squeeze the water out, and the sludge is then put into a big hopper that goes to either a landfill or a place that reuses the sludge. The water from this process is typically reused and added to the front end of the clarifier.

Filtration

The next step is generally running the water overflow into gravity sand filters. These filters are big areas where they put two to four feet of sand, which is a finely crushed silica sand with jagged edges. The sand is typically installed in the filter at a depth of two to four feet, where it packs tightly. The feed water is then passed through, **trapping the particles**.

On smaller industrial systems, you might go with a packed-bed pressure multimedia filter versus gravity sand filtration. Sometimes, depending on the water source and whether or not it has a lot of iron, you can also use a green sand filter instead of the sand filter, but for most part, the polishing step for conventional wastewater treatment is sand filtration.

Ultrafiltration (UF) can also be used after the clarifiers instead of the gravity sand filter, or it can replace entire clarification process altogether. Membranes have become the newest technology for treatment, pumping water directly from the wastewater source through the UF (post-chlorination) and **eliminating the entire clarifier/filtration train**.

Disinfection

After the water flows through the gravity sand filter, the next step is typically disinfection or chlorination **to kill the bacteria in the water**.

Sometimes this step is done upstream before filtration so the filters are disinfected and kept clean. If your system utilizes this step prior to filtration, you will need to use more disinfectant . . . this way the filters are disinfected and kept free from bacteria (as well as the filtered water). When you add the chlorine upfront you're killing the bacteria and have less fouling. If bacteria sits in the bed, you might grow slime and have to backwash the filters more often. So it all depends upon how you're system operates . . . whether your system is set up to chlorinate upstream (prior to filtration) or downstream (after filtration).

Distribution

If the wastewater is being reused in an industrial process, it's typically pumped into a holding tank where it can be used based on the demands of the facility. If for municipal use, the treated water is usually pumped into a distribution system of water towers and various collection and distribution devices in a loop throughout the city.

Lime softening

In waters where you have high hardness or sulfates, or other constituents you need to precipitate or take out, a lime and/or a lime soda process is used. It **raises the pH, causing hardness and metals in the water to precipitate out**. Cold, warm, or hot lime processes can be used, and each will yield a different efficiency. In general, hotter water removes more hardness.

Ion exchange softening

In some industrial and municipal applications, if there's high hardness, there may be post treatment for the removal of the hardness. Instead of lime, a softening resin can be used; a strong acid cation exchange process, whereby resin is charged with a sodium ion, and as the hardness comes through, it has a higher affinity for calcium, magnesium, and iron so **it will grab that molecule and release the sodium molecule into the water**.

Special processes

As we stated above, wastewater and effluent regulations differ everywhere you go. We have discussed some of the most common steps in a wastewater treatment plant. Typically there are special process steps to treat for a specific issues, such as the removal of certain metals or organics, or to reduce TDS for recycling etc. For these various problems specific to your individual needs, careful consideration must be given for the proper method of treatment

Chapter Two

IS WASTEWATER TREATMENT NECESSARY FOR YOUR FACILITY?

THE IMPORTANCE OF WASTEWATER TREATMENT

Is it necessary for your facility?

It's important to understand how wastewater treatment can play a significant role in the overall health of your business, as ignoring any treatment needs your facility might have could earn your company various fines or lawsuits and pose a potential threat to public health.

This chapter breaks down **the importance of wastewater treatment for your facility and whether it's necessary** by examining some of the most common wastewater contaminants and possible outcomes if left untreated in addition to required permits and effluent regulations:

What kind of pollutants can you find in wastewater?

Wastewater is the byproduct of plant processes and uses, so the pollutants present in the wastewater stream will vary depending on what it is exposed to. As listed briefly in the previous chapter, some common contaminants include:

Biochemical oxygen demand

Biochemical oxygen demand, or BOD, refers to the amount of dissolved oxygen needed by aerobic biological organisms to break down organic matter into smaller molecules. High levels of BOD indicate an elevated concentration of biodegradable material present in the wastewater and can be caused by the introduction of pollutants such as fecal waste or fertilizer runoff. It can also be elevated by organic waste, whether by domestic or industrial sources. When these levels are elevated, this can deplete the oxygen needed by other aquatic organisms to live, leading to algal blooms, fish kills, and harmful changes to the aquatic ecosystem where the wastewater is discharged.

Nitrates and phosphates

If large amounts of nitrates and/or phosphates are not removed from wastewater and these nutrients are discharged into local environments, they can increase the BOD and lead to extensive weed growth, algae, and phytoplankton. This can further lead to eutrophication, or the deoxygenation in a body of water, killing the organisms and potentially leading to hypoxia or environmental dead zones. They can enter the wastewater stream a variety of ways, including human and food waste, detergents, and pesticides.

Pathogens

Pathogens are bacteria, viruses, fungi, or any other microorganisms that can be present in wastewater that can lead to all kinds of health issues, including acute sickness, severe digestive problems, or death. When domestic or industrial wastewater contains these harmful pathogens and is not treated, it can spread illnesses and diseases such as cholera, dysentery, salmonellosis, hepatitis A, botulism, and giardiasis, to name a few. Humans are most likely to ingest pathogens by drinking and/or eating contaminated beverages and/or food.

Metals

Mostly found in wastewater as a result of various industries, manufacturing processes, and household piping, when left in wastewater in high concentrations, metals can cause extensive damage to the environment and human health. They are particularly damaging because they don't break down and tend to accumulate, causing toxic environs.

Some of the more common metals found in wastewater are outlined below along with their potential effect on humans and the environment. The mentioned effects are according to the Agency for Toxic Substances and Disease Registry (a federal public health agency of the U.S. Department of Health and Human Services):

- **Cadmium;** often used in manufacturing batteries, pigments, and platings, in humans, this metal can lead to lung damage, gastrointestinal issues, kidney damage, and death. It has also been linked to lung cancer.
- **Chromium;** this metal, often used to make various metal alloys (such as stainless steel) can cause skin irritations, difficulty breathing, ulcers, anemia, and harm to the male reproductive system. It is labeled as a carcinogen.
- **Copper;** found in electrical wiring, pipes, sheet metal, etc., copper can also be used to treat plant disease, for water treatment, or as a preservative. Copper, in high doses, can cause irritation of the nose, mouth, and eyes. It can also induce headaches, dizziness, nausea, and diarrhea.
- **Lead;** commonly found in pipes and storage batteries, among others, lead contamination can lead to serious health issues in both children and adults.
- **Manganese;** used in steel production to improve hardness and strength, manganese can also be used in the production of batteries paints, and cosmetics. Exposure to manganese in large quantities can cause damage to the nervous system, leading to slowness and behavioral changes or poor concentration.

- **Mercury;** often entering the atmosphere from mining deposits, the emissions of coal-fired power plants, burning municipal and medical waste, the production of cement, and uncontrolled releases in factories that use mercury, the metal can lead to damage of the brain and nervous system and is very toxic to the human body.

Total suspended solids

Total suspended solids (TSS) in wastewater, the organic and inorganic solid material suspended in the water, can, like many of the other contaminants listed, harm aquatic life. They can also be problematic if the wastewater is being reused for a process, so depending on whether or not you need to discharge your wastewater in a POTW or to the environment, or reuse the wastewater for your process, will determine how harmful the TSS will be. TSS can decrease levels of oxygen in aquatic environments and kill of insects. They can also scale and foul piping and machinery.

Total dissolved solids

Total dissolved solids (TDS) are any anions, cations, metals, minerals, or salts found in wastewater. They can cause issues with aquatic life, irrigation and crops, and they can also seep into groundwater. TDS can be generated in wastewater from just about any industry.

Synthetic chemicals

When pesticides and other chemicals are used in the manufacturing process, they can be transmitted to humans and the environment through wastewater, causing damage to the environment and human health. Some common chemicals found in wastewater include diethylstilbestrol, dioxin, PCBs, DDT, and other pesticides. These "endocrine disruptors" can block hormones in the body and affect the functions these hormones control.

What are wastewater treatment options and regulations to be mindful of?

When it comes to handling wastewater, depending on what your facility is doing with the water will how you're going to treat it. A few common scenarios are described below:

Reusing/recycling wastewater for your process

Treating your wastewater to recycle/reuse it can be especially helpful in areas with low water resources. (Facilities in California might seek to do this, for example, as the state is currently experiencing drought.) In addition to conserving water, this can help your facility save on connection fees that might be extremely high due to the shortages. Your wastewater treatment options, in this case, will depend on what contaminants are present because of your production process or whether you operate a municipal facility. It is important to be aware of the treatment necessary to ensure efficient water recovery.

Releasing wastewater into the environment

If your facility plans to release your wastewater into the environment in the United States, you will need to do so under a National Pollutant Discharge Elimination System or NPDES permit. These permits, enforced under the Clean Water Act, place limitations on what can be discharged, set requirements for reports and monitoring, and are put in place to ensure pollutants are not released in harmful amounts.

Your local regulations and the contaminants present in your wastewater will determine what treatment is necessary for your facility. The EPA operates 10 different offices in the country that address different regions, so to make sure your facility is complying with local regulations, be sure to check in with your local NPDES representatives. Failure to meet requirements could incur heavy fines.

Discharging wastewater into the local municipality

Your local municipality might take your effluent, but chances are they'll want you to clean it first. Check with your local POTW to be sure you're meeting their qualifications. Your wastewater treatment will need to remove the contaminants they don't allow or, again, it can cost you thousands of dollars in fines down the road.

Do you need to treat your wastewater?

Because failing to treat your wastewater can potentially harm the environment, human health, and your process, in addition to preventing your facility from meeting local POTW or NPDES discharge regulations and causing your facility to incur heavy fines and possible legal action, it is strongly advisable that you take the proper steps to ensure the proper treatment of your wastewater before it's recycled/reused and or discharged into the environment or POTW.

Chapter Three

SEVEN WAYS YOUR FACILITY ISN'T MEETING EFFLUENT REGULATIONS AND HOW TO CHANGE IT

IS YOUR FACILITY MEETING EFFLUENT REGULATIONS?

Here are seven ways it might be falling short

It's important to understand how wastewater treatment can play a significant role in the overall health of your business, especially when it comes to meeting effluent regulations.

Again, ignoring these regulations and whether or not your facility is meeting them could earn your company various fines or lawsuits and pose a potential threat to public health.

The guidelines that affect your facility will vary depending on its location, industry, and whether the effluent is being discharged into the environment under a National Pollutant Discharge Elimination System (NPDES) permit or to the local publicly owned treatment works (POTW) facility.

This chapter breaks down **seven ways your facility might not be meeting these regulations and how you can fix it**.

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1. Your effluent has a high level of biochemical oxygen demand

The problem

Regulations often limit the amount of biochemical oxygen demand, or BOD, your facility is allowed to discharge. As mentioned in a previous chapter, BOD refers to the amount of dissolved oxygen needed by aerobic biological organisms to break down organic matter into smaller molecules. When these levels are elevated, this can **deplete the oxygen needed by other aquatic organisms to live, leading to algal blooms, fish kills, and harmful changes to the aquatic ecosystem** where the wastewater is discharged. For this reason, many effluent regulations place limitations on these levels, ensuring local waterways are preserved and left unharmed.

Possible solutions

When soluble organics are consumed by bacteria, they are converted to carbon dioxide and biological floc, which are both then settleable from the effluent. Reducing the organic content of the effluent and improving BOD levels, the process mentioned (called biological oxidation) is a popular method to control BOD and is achieved by fostering the right balance of “food” and organic matter. This can be achieved with the proper method of aeration, whereby air in introduced into the effluent in order to increase the rate of this biological oxidation which, in turn, increase the level of settleable solids that can then be removed from the effluent by process of filtration or clarification.

2. Your effluent contains too many total suspended and dissolved solids

The problem

Many effluent limitations include some kind of guideline on the level of total suspended solids (TSS) or total dissolved solids your facility is allowed to discharge.

TSS, or the organic and inorganic solid material suspended in the water, can harm aquatic life when present in high concentrations in wastewater. **TSS can decrease levels of oxygen in aquatic environments** and kill of insects. They can also scale and foul piping and machinery.

TDS are any anions, cations, metals, minerals, or salts found in wastewater. They can **cause issues with aquatic life, irrigation and crops, and they can also seep into groundwater**. TDS can be generated in wastewater from just about any industry.

Possible solutions

Depending on the level of TSS and TDS your facility is seeing in its wastewater and the regulations set by your local effluent guidelines, your methods and the degree in which you implement them will vary. In general, **the following methods are some of the treatments useful for reducing TSS:**

- Coagulation
- Flocculation
- Sedimentation
- Sand or carbon filtration

TDS reduction is a bit more complicated endeavor. If the contaminants are metal-based such as calcium, magnesium, or iron a simple chemical addition to the clarification process can be added to reduce these. If they are sodium, chloride, or other highly soluble ions, demineralization and/or evaporation may be required.

3. Your effluent has an increased amount of nitrates and phosphates

The problem

As mentioned in a previous chapter, if large amounts of nitrates and/or phosphates are not removed from wastewater and these nutrients are discharged into local environments, they can increase the BOD and lead to extensive weed growth, algae, and phytoplankton. This can lead to eutrophication, or the deoxygenation in a body of water, killing the organisms and potentially leading to hypoxia or environmental dead zones. They can enter the wastewater stream a variety of ways, including human and food waste, detergents, and pesticides. For these reasons, limitations on these contaminants are usually strictly enforced.

Possible solutions

If your facility isn't meeting your nitrate and phosphate effluent levels, the following methods might be useful:

- **Nitrate removal**: Nitrates can be removed by several methods, including ion exchange, reverse osmosis, or conventional biological treatment and denitrification. Treatment usually is a combination of technologies, so for the best solution for your facility, be sure to work with your wastewater treatment specialist.
- **Phosphate removal**: An effective way to remove phosphates from you wastewater stream is often coagulation/chemical precipitation, depending on the types of phosphates present. Some biological treatments, such as the use of an anaerobic reactor (converts organic matter to methane and carbon dioxide) and aeration tank (injects oxygen to encourage biological floc formation), can be useful, as well.

4. Your wastewater contains oil and grease

The problem

Oil and grease are "hydrophobic," which means they tend to repel from water and cling to surfaces free from water. High amounts of oil and grease in wastewater **can clog sewer and drainage pipes in addition to harming human health and killing aquatic life**, depending on the concentration and type of oil/grease. Often introduced into wastewaters as byproducts of food production, these contaminants are strictly regulated from being released with your effluent.

Possible solutions

Some facilities that see large amounts of oil and grease in their wastewater will use **dissolved air flotation (DAF)**. This device that removes the oil by dissolving air in the stream under pressure. When the bubbles float to the surface, they attach to the oil and grease so they can be skimmed off the top of the surface. Another method to successfully remove oil and grease might include **some types of filtration**, such as ultrafiltration or activated carbon.

5. Amount of water being discharged is more than your limited volume

The problem

Does your area have connection fees for discharging treated wastewater? Many times the fee is based on the volume of water your plant requires and varies based on whether you are discharging to the local municipal facility or into the environment. Regulations are typically stringent and are becoming more so every day, as some facilities might not be able to accommodate a high volume of effluent.

Possible solutions

In order to comply with your local regulations and avoid expensive fees, measures to reduce your wastewater effluent can include **treating your effluent for reuse or even zero liquid discharge.**

When done efficiently, this can help save your facility energy in processing waste as well as how much water you'll need for your process. Reverse osmosis, nanofiltration, ultrafiltration, and other technologies (such as ion exchange) can help your facility recycle your wastewater for reuse. Depending on your process and the quality of water required for your process, your treatment needs might vary.

6. You're not keeping up to date with regulations in your industry

The problem

Wastewater effluent regulations change all the time, and it's important to keep up to speed with these changes. They also vary depending on the industry your company serves as well as where your facility is located.

Possible solutions

It seems obvious, but make sure you reach out to your local regulators. They might be able to provide you with a representative for your area that can relay any changes to your facility. It is also useful to have a wastewater treatment expert in the area who is familiar with the changing regulations.

They can often help your facility keep your effluent quality in compliance. In short, a little effort in being prepared can go a long way in helping your facility avoid fees and having your permit to discharge revoked.

Meeting local POTW or NPDES discharge regulations should remain a priority for your facility. Wastewater treatability studies can help your facility determine how to meet these regulations, so be sure you consider testing your wastewater streams prior to implementing the technology to think might solve your contamination issues. This can help you save time and cost in the long run.

Chapter Four

HOW MUCH DOES A WASTEWATER TREATMENT SYSTEM COST?

HOW MUCH A WASTEWATER TREATMENT SYSTEM COSTS

Pricing, factors, etc.

When industrial companies look into purchasing a wastewater treatment system for their plant, first and foremost they want to know, "**How much does a wastewater treatment system cost?**" Because wastewater treatment is a highly complex, custom solution, several factors go into choosing the right treatment options. Let's look at what a typical wastewater treatment system might include and break down the main factors, considering how they fluctuate cost:

The main factors of wastewater treatment cost

All in all, there are two main factors that drive the cost of a wastewater treatment system:

- What is the quality (levels of contaminants) of the plant's effluent and what are the local maximum and average monthly discharge limits to the environment or POTW?
- What amount of water do you need to process per day and how fast? (This is your required peak gallons per minute, or GPM.)

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If you can answer these questions, it will help you narrow down what your needs might be and provide a better sense of the budget you might be looking at.

The quality of your effluent and the equipment needed to treat it

One of the largest factors that will determine the cost of your wastewater treatment system is the equipment that will go into the actual makeup of the system.

Here are some important questions to address:

- Does your plant process foods that leave you with wastewater heavy in BOD, oils, and grease?
- Does your process include the manufacturing of metals that contaminates the wastewater with suspended solids and metals such as zinc, iron, lead, and nickel?
- Do you see high levels of inorganic contaminants or need to remove BOD or COD (chemical oxygen demand)?

All these factors will determine what type of wastewater treatment system you need.

For example, if your plant runs a plating operation, some of the issues we often see are the need for pH stabilization, suspended solids, and metals removal.

A wastewater treatment system here will usually have physical chemical clarification and metals removal. At 100–500 GPM, equipment for a wastewater treatment system can be anywhere from **$200,000–$700,000**, depending on the level of contaminants in relation to the local discharge regulations.

Another example is a food-based plant with treatment needs for wastewater from manufacturing products like milk, dairy products, beverage making, etc.

Typically with a food and beverage manufacturing facility, technology will revolve around the removal of biological contaminants (with technology such as membrane bioreactors, or MBRs) and oil/grease (with dissolved air flotation, or DAF). At 100 GPM, the system can run you anywhere from **$500,000 to over $1 million**, depending on the levels of BOD and the discharge limits.

Flow rates in relation to the capital cost of your system

In general, if your plant runs consistently at a lower flow rate, you're usually looking at a lower capital cost for your wastewater treatment system.

If your plant generally runs a greater flow in a shorter amount of time, your capital cost is usually higher for equipment.

Flow rates are always factored into the wastewater treatment system cost, so be sure you measure this as efficiently as possible prior to requesting a quote in order to get an accurate cost estimate for your system. Typically inlet buffering tanks are installed to minimize the peaks in flow and concentration of contaminants.

Other important factors to consider

Upfront planning. Developing the concepts, designs, and regulatory requirements for your project is the first step to planning your wastewater treatment system. The cost of engineering for this type of project can typically run 10–15% of the cost of the entire project and is usually phased in over the course of the project, with most of your investment being allocated to the facility's general arrangement, mechanical, electrical, and civil design.

Space requirements. When planning for a wastewater treatment system, the size of your system will affect your cost, and the footprint is usually large, so keep in mind that sometimes your plant location can affect the cost of your system. For example, if your plant is located in a place that is very expensive when it comes to space, you might want to aim for a smaller footprint, if possible.

Installation rates. Another thing to keep in mind is the installation rates in your area. These sometimes also fluctuate by location, so be sure you're aware of the cost to install the system and factor this into your budget. In areas where installation costs are high you may want to consider prepackaged modules versus build-in-place facilities.

Level of system automation needed. When it comes to the level of automation you need for your wastewater treatment system, there are two options. The first is a higher level of automation where you won't need an operator present for much of the time. With type of automation, you can eliminate much of the human error associated with running the plant, and although this option is more costly upfront (an initial investment in more sophisticated PLC controls and instrumentation), the ongoing labor costs are less. The second option is a lower level of automation with less capital cost, but with added labor, this can end up costing you more in the long run. When deciding whether or not to invest in more costly controls, you need to consider what works for your company and staffing availabilities.

***Turnkey and prepackaged systems*.** If you are able to order your wastewater treatment system prepackaged, this will typically save you about three months in construction time at about the same cost or less. A benefit to having your system prepackaged is that the production facilities and fabrication shops that assemble your system are, more often than not, highly knowledgeable about the type of system they are manufacturing. This results in a quick and efficient fabrication versus build-in-place facilities. Sometimes when you hire a field crew, there is a bit of a learning curve that can add extra time and/or cost to a project. SAMCO specializes in these types of turnkey, prepackaged systems, and for more information about what we offer, you can visit our website here. Installation costs will vary, but typically range between 15–40% of the project cost, depending on the specifics of prepackaging and amount of site civil work needed.

***Shipping the system to your plant*.** When having your wastewater treatment system shipped to the plant, you usually want to factor in about 5–10% of the cost of the equipment for freight. This can vary widely depending upon the time of year you are purchasing your system in addition to where your plant is located in relation to the manufacturing facility. When you are looking to purchase your system, check with your manufacturer to see if there is a facility where the system can be constructed closer to you, if not on-site.

***Operation costs*.** Also keep in mind that particular technology packages cost a certain amount to purchase upfront, but you need to also factor in system operating costs over time. For decisions like these, you need to weigh the pros and cons of initial versus long-term cost investment in addition to what works for your company and staff. You will likely want to look into having someone develop an operating cost analysis so your company can plan ahead for the operating cost over your wastewater treatment plant's life cycle. This might help you consider whether or not you want to spend more on your system initially or over time.

Other possible costs and fees. When purchasing a wastewater treatment system, you might also want to keep in mind what other hidden costs and fees might be. For example: Will there be any taxes on the system or additional purchasing fees? What are your possible utility costs to the installation area? Will there be any environmental regulatory fees and/or permits? Any ongoing analytical compliance testing you need to pay for?

It is important to understand and look into any extra costs or hidden fees you might incur. For example, does your area have connection fees for discharging treated wastewater? For more information about the possible connection fees in your area, check with local regulators. Many times the fee is based on the volume of water your plant requires and varies based on whether you are discharging to the local municipal facility or into the environment. Regulations are typically stringent and are becoming more so every day. There is also typically consistent monitoring over time required. You will need to acquire some sort of permit to discharge and you're your plant approved before releasing any waste, and failing to comply to your local restrictions can result in heavy fines, so it's worth making sure you're on top of the current requirements in your area.

Also consider that there will be costs to treating the secondary waste produced by the system. With stringent environmental regulations, you will need to either treat the waste for hauling away or solidify with a filter press/evaporator and transport to third party disposal firm. You can learn more about SAMCO's wastewater treatment systems on our website here.

Also be sure to ask your system manufacturer about options that might be cheaper to install. They might be able to shed some light on the more installation-friendly systems with suggestions on how to keep your costs to a minimum.

The bottom line

When it comes to treating your wastewater, even though the treatment option and costs can be complex, all in all, you are looking at a **$500,000 to $1.5 million** system at 150,000 GPD when you factor in all the needed equipment, engineering, design, installation, and startup.

Chapter Five

HOW TO CHOOSE THE BEST WASTEWATER TREATMENT SYSTEM FOR YOUR PLANT

CHOOSING A FACILITY'S WASTEWATER TREATMENT SYSTEM

What to look for when making your decision

The best wastewater treatment system for a facility will help it avoid costly discharge and connection fees, among other problematic issues, and/or efficiently treat the wastewater for reuse.

But **how do you choose the best wastewater treatment system for your plant**?

The answer to this question can sometimes be a bit complex and depends on a variety of factors. We've simplified and broken down what this might mean for your plant below:

Main factors to consider when choosing a wastewater treatment system

There are three main factors that will help you choose the ideal wastewater treatment system:

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- What are the **wastewater characterizations** of the production facility?
- What are the **regulatory requirements for discharge** from the plant?
- What are the outcomes of a thorough **wastewater treatability study and pilot test**?

Let's break down each factor individually and simplify how these might affect your decisions:

How do the wastewater characterizations of your facility determine your ideal wastewater treatment system?

One of the largest factors that will determine the best wastewater treatment system for a facility is the equipment that will go into the actual makeup of the system.

Here are some important questions to address:

- Does the plant process foods that leave you with wastewater heavy in BOD, oils, and grease?
- Does the facility's process include the manufacturing of metals that contaminates the wastewater with suspended solids and/or metals such as zinc, iron, lead, and nickel?
- Are there high levels of inorganic contaminants or need to remove BOD or COD (chemical oxygen demand)?

All these factors will determine what type of wastewater treatment system is needed.

For example, if a plant runs a plating operation, some of the issues often addressed are pH stabilization and suspended solids and metals removal. A wastewater treatment system in this case will usually have some type of physical/chemical clarification and metals removal.

Another example could be a food-based plant with treatment needs for wastewater from manufacturing products like milk, dairy products, beverage making, etc. Typically with a food and beverage manufacturing facility, technology in the wastewater treatment system will revolve around the removal of biological contaminants (with technology such as membrane bioreactors, or MBRs) and oil/grease (with dissolved air flotation, or DAF).

What are the regulatory requirements for discharge from the plant?

When it comes to handling wastewater, depending on what your facility is doing with the water will determine how you're going to treat it and what technologies will go into the makeup of the system.

Two common discharge scenarios are described below:

Releasing wastewater into the environment

If your facility plans to release your wastewater into the environment in the United States, you will need to do so under a National Pollutant Discharge Elimination System or NPDES permit. These permits, enforced under the Clean Water Act, places limitations on what can be discharged, set requirements for reports and monitoring, and are put in place to ensure pollutants are not released in harmful amounts. Your local regulations and the contaminants present in your wastewater will determine what treatment is necessary for your facility and what will go into your system. The EPA operates 10 different offices in the country that address different regions, so to make sure your facility is complying with local regulations, and be sure to check in with your local NPDES representatives. Failure to meet requirements could incur heavy fines.

Discharging wastewater into the local municipality

Your local municipality might take your effluent, but chances are they'll want you to clean it first. Check with your local publicly owned treatment works (POTW) to be sure you're meeting their qualifications. Your wastewater treatment will need to remove the contaminants they don't allow or, again, it can cost you thousands of dollars in fines down the road. The facility's wastewater treatment system will need to address and remove any contaminants present to acceptable levels that are required when discharging into the local POTW.

What is the result of a treatability study and/or pilot test?

A wastewater treatability study is a **study or test that will determine *if* the wastewater can be treated for your process and *how* it needs to be treated**. If the study is done correctly, it will clearly identify the contaminants present in your wastewater stream, helping ensure the proper treatment solutions are considered and implemented in your wastewater treatment system.

This step is **critically important** when choosing the best wastewater treatment system for your plant. After having a roadmap of maybe two or three technology platforms that meet your base and operating cost, running an efficient treatability test will help validate the assumptions you've made about possible contaminations and solutions to remove them. This streamlines to process and takes out any guesswork, ensuring your facility is getting the best possible solution for your unique situation.

Also keep in mind that even though the study might seem thorough on paper, **there's nothing better than running pilot testing in the field to validate the treatment/technology assumptions, optimize design,** because during this phase, other problems can arise and be found prior to choosing the components of your system, which can help save you from any effluent violations down the line.

Choosing the best wastewater treatment system for your plant is **a very complex process** and requires a substantial amount of effort and time to do it properly.

Now that you know the most important aspects to focus on, make sure you choose to work with an engineering company that can help you sort through all these requirements in order to choose the best system possible. Knowing the **characterization of contaminants in your wastewater**, local **effluent regulations**, and results of a **thorough treatability study and pilot test** will help steer you in the right direction.

HOW CAN SAMCO HELP?

SAMCO has over 40 years' experience helping design and engineer some of the most complex wastewater treatment systems in the water industry. For more information about what we offer and how we can help, please visit our website or contact us to schedule a consultation with one of our skilled engineers.

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